Great Northern
LANDSCAPE CONSERVATION COOPERATIVE

An Analysis of Meta-Information For Landscape Conservation in the Great Northern Area

Quarterly Progress Report – July 11, 2011

An Analysis of Meta-Information for the Great Northern Area is considered a "living" document and will be updated quarterly. For questions about this analysis, please contact:

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Introduction

The Great Northern Landscape Conservation Cooperative (GNLCC) is supporting 28 science projects focused on delivering a shared information base in an effort to achieve its stated goal "to coordinate, facilitate, promote and add value to large landscape conservation to build resource resilience." In FY 2010 and 2011, the GNLCC committed over $2.4 million to a range of partners and landscapes. To promote documentation and dissemination of information for use in landscape-scale conservation, this document is being developed as a quick reference and integration guide to the data, models, tools, and documents for GNLCC's conservation partners.

All products will be documented with product-type appropriate metadata and stored on the GNLCC's Landscape Conservation Management and Analysis Portal, LC MAP. Some products are also accessible through project websites. LC MAP is a comprehensive tool to create, manage, document, and analyze geospatial data. It provides a virtual collaborative workspace allowing multiple partners to securely share and access common datasets and information to further coordinated research, management, and resource conservation.

This document includes the first portion of Phase I: Summary of information specific to the GNLCC. In all, there will be 4 phases:

I. Summary of information: An overview of projects including an index of data, maps, models and tools (GNLCC and other landscape science and information);
II. A shared information base: Integrating, interfacing, and making compatible data and tools;
III. The recipe for applying science to landscape: Geospatial layers, land treatment layers, ecological and species modeling and validation, predicted outcomes, vulnerability assessments, and landscape strategies;
IV. Applications and use in landscape management or natural resource decision-making.

The analysis of meta-information is considered a "living" document and will be updated quarterly. Additionally, it will be used by the GNLCC Steering Committee and their partners in conjunction with the GNLCC Strategic Conservation Framework *(in prep., expected availability Spring 2012*) to identify science needs and develop and implement strategies that can effectively achieve common landscape conservation goals.

This table summarizes the products derived (or to be derived) from the GNLCC FY 2010 and 2011 supported projects. In some cases, notably peer-reviewed publications, numbers are estimated because exact tallies are not yet known. The 'Count' indicates the total number of products described in proposals submitted for funding. In some cases, more derived products are expected, as indicated by '>'. The 'Completed' field will be updated regularly. Product details are listed in Appendix I.

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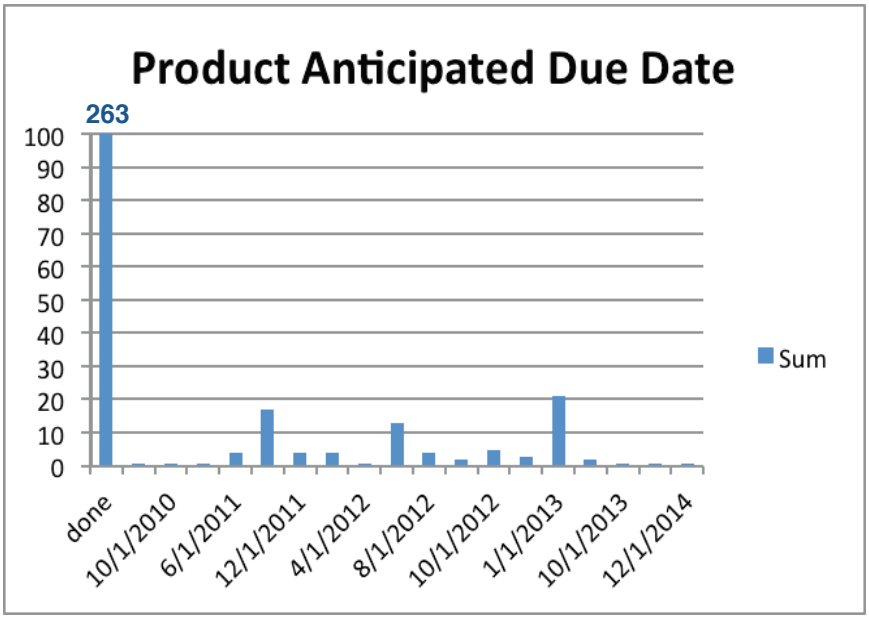
Product Type, Count, and Completion Status for GNLCC FY 2010 and 2011 Supported Projects

PRODUCT	COUNT	COMPLETED (as of 7/15/11)
Digital Data		
Spatial data layer/database	>325	235
Maps	>28	19
Tables	6	3
Tools		
Spatial Analysis	6	1
Decision Support	5	
Models	5	
Information / Training	7	1
Reports		
Agency – Planning	13	
Agency – Results	15	2
User's Manual	1	1
Peer-reviewed Publication	17+	
Presentations	10	
Workshops	8	3

To date, about two-thirds of the products have been delivered. The anticipated due dates for the remaining product sets are indicated in the graph.



Project Summaries

Projects Supported in FY 2010 and FY 2011

Title	Lead Sponsor / PI	Product Due Date	Funding Allocation
The Washington Connected Landscapes Project, Part I: Supporting Connectivity Conservation Now and Under Future Climates	**Washington Departments of Fish and Wildlife & Transportation / Schuett-Hames, J.**	**9/12 (begin delivering tools in 2/11)**	**FY10 $304K FY11 $150K**

Directly supports three LCC objectives and functions: 1) Decision support tools/systems or science applications for focused resource conservation, 2) testing assumptions of model predictions, and 3) inventory of resource conditions or trends. Final products include analysis and decision support tools for connectivity conservation and climate adaptation, rigorous tests of emerging strategies for connectivity conservation and climate adaptation planning, and connectivity analyses that will describe resource conditions in Washington and adjacent landscapes under both current conditions and future climate scenarios.

FY 2010

Objectives:

- Complete statewide and ecoregional connectivity analyses and publish results
- Identify linkages most likely to sustain connectivity and facilitate species movements under climate change
- Develop and share methods, protocols and spatial analysis tools for connectivity prioritization

Deliverables (due date):

1. Summary report of statewide analysis, including high quality map products (10/10)
2. Summary report of Columbia Plateau ecoregional analysis, including high quality map products (10/11)
3. Reports and searchable map layers for statewide and ecoregional analyses on web and six presentations to diverse stakeholder groups (2/11–7/12)
4. Updated statewide connectivity products identifying priority connectivity areas in light of climate change (5/11)
5. “Climate-smart” Columbia Plateau connectivity analysis, and associated decision support framework (10/11)
6. Reports and searchable map layers for “climate-smart” analyses on web (7/11–7/12)
7. Updated statewide connectivity products identifying priority connectivity areas for species shifts in response to climate change (7/12)

8. Adaptive management protocols to inform future "climate-smart" connectivity planning (7/12)
9. Spatial analysis decision support tools: At least 4 conference and workshop presentations, and four publications in peer-reviewed journals (2010–12)
10. First release of spatial analysis toolset with user guide to implement our analysis methods in other regions (ongoing releases and support anticipated) (11/10)
11. Climate-smart tools and protocols; four conference and workshop presentations, and four publications in peer-reviewed journals (2010–12)

FY 2011

Objectives:

- Conduct ecoregional connectivity analyses and publish results for the Columbia Plateau
- Incorporate climate change into statewide and ecoregional connectivity analyses
- Develop and share methods, protocols, and spatial analysis tools needed for climate and Columbia Plateau analyses

Deliverables (due date):

1. Summary report of Columbia Plateau ecoregional analysis, including high quality map products and obtain feedback through two workshops with Arid Lands Initiative (12/11)
2. Establish Okanogan transboundary and ecoregional subgroups and establish geographical analysis boundary (12/12)
3. Reports and searchable map layers for Columbia Plateau analysis on web (7/12)
4. Enhanced linkage modeling products (choke points, restoration opportunities, centrality) and four presentations to diverse stakeholder groups (9/12)
5. Release online report, searchable map layers, and decision support for: Statewide climate refugia linkage analysis (6/12) and Columbia Plateau ecoregional climate refugia linkage analysis (7/12)
6. Integrate downscaled climate projections into climate refugia analysis (7/12)

Washington Wildlife Habitat Connectivity Working Group: http://www.waconnected.org/
Linkage Mapper: http://www.waconnected.org/habitat-connectivity-mapping-tools.php
Documentation: http://code.google.com/p/linkage-mapper/

Title	Lead Sponsor / PI	Product Due Date	Funding Allocation
Predicting Effects of Climate Change on Aquatic Ecosystems in the Great Northern Landscape: Combining Vulnerability Assessments, Landscape Genomics, and Modeling for Conservation	**US Geological Survey / Muhlfeld, C.**	**2011 with additional products scheduled for outyears**	**FY10 $142K FY11 $120K**

The project will apply new and existing techniques for combining downscaled climate spatial data with fine-scale aquatic species vulnerability assessments (invertebrates→fish), population genetic data and remotely sensed riparian and aquatic habitat analysis. Results may be used to identify populations and habitats most susceptible to the impacts of climate change; develop monitoring and evaluation programs; inform future research needs; and develop conservation delivery options in response to climate change and other stressors (e.g., habitat loss and invasive species) that are often complicated or exacerbated by climate change.

FY 2010 and 2011 Deliverables (due date):

1. High resolution climate data sets produced by our regional climate models (2011)
2. High resolution (<1m) habitat classification and analysis of selected and representative stream reaches, from alpine to valley floor) (2012–14)
3. Fine scale species distribution modeling with supportive data with scenarios for agency conservation strategies and conservation efforts (2011)
4. Physiological responses of aquatic organisms to changes in flow and temperature (2011–14)
5. Data sharing in the GNLCC [Data will be made available to resource managers dealing with aquatic systems, including the Crown Managers Partnership, USGS, FWS, USFS, BLM, state management agencies, and private organizations (e.g., Trout Unlimited)] (2011–14)
6. Species-specific decision support tools (Bayes nets) will be made available from the USGS fish-climate project that will incorporate our results. These will be portable, and designed to permit fish managers to quickly and efficiently assess extinction risk and the outcome of management actions. (2012)
7. Workshops to present the results and decision support tools to managers and provide hands-on training (2012–14)
8. Multiple peer reviewed publication(s) of the study (2011–14)

Title	Lead Sponsor / PI	Product Due Date	Funding Allocation
Document Fine Scale Linkage Areas and Conservation Delivery in the Northern Rockies of US and Canada	**US Fish and Wildlife Service / Servheen, C.**	**4/13**	**FY10 $195K FY11 $77K**

This project is an initiative to secure landscape-scale movement opportunities for multiple wildlife species in the Rocky Mountains of Montana and Idaho and adjacent transboundary areas of British Columbia and Alberta. Identify specific wildlife linkage locations across highways 1, 2, 200, 95 and I-90 in Northwest Montana and North Idaho. Recommend and implement with partners conservation delivery in these areas on public and private lands, and across highways to make these movement areas more permeable to wildlife.

Deliverables (due date):

1. Reports of the grizzly bear habitat modeling process and the identification of linkage and core areas for Highways US 2, MT 200, US 95 and ID 1 based on data gathered around Highway 3 in British Columbia; report will recommend appropriate conservation actions such as land acquisition, conservation easements, linkage oriented management, sanitation, and public outreach (4/13)
2. Reports of the black bear habitat modeling process and the identification of linkage areas for Highways US 2, BC 3, US 95, and ID 1 based on local black bear data gathered previously; report will recommend conservation actions; modeling efforts for black bears will be compared with grizzly outputs from deliverable 1 (above) to describe similarities and differences (9/30/11)
3. A database of collared black bears and hair snagging near Highway MT 200 and I-90 to provide for modeling black bear linkage habitat across MT 200 and I-90; annual progress reports will be provided by March 31 (4/13)
4. Conduct genetic-based parent-offspring analysis with expanded genotypes that will result in our ability to detect and therefore monitor movements and breeding of bears across landscape fractures; report detailing this procedure and our results for grizzly bears across the fragmenting Highways BC 3 US 95, and ID 1 separating the Purcell and Selkirk Mountains (12/11)

Title	Lead Sponsor / PI	Product Due Date	Funding Allocation
Species Adaptations to Climate Change: Baseline Data for Grassland, Sagebrush, and Riparian-associated Landbirds in Bird Conservation Region 10	**Montana Department of Fish, Wildlife and Parks / Wightman, C.**	**4/11–1/13**	**FY10 $35K FY11 $25K**

This work will provide baseline data for science, modeling, and conservation needs to the GNLCC and partners. It will fill identified gaps in existing data identified by the Intermountain West Joint Venture and other leaders in conservation science in the Northern Rocky Mountains.

Deliverables:

1. A BCR 10 wide grid that can be used to design studies for other taxonomic groups
2. Data will be stored with Rocky Mountain Bird Observatory, who is a node to the Avian Knowledge Network. Detailed data is available to funding partners for analysis. Summarized data is available to nonfunding partners.
3. Annual reports with density and occupancy estimates by stratum will be prepared by March of the following year
4. Numerous partner products will be prepared, included MaxEnt models by Montana Natural Heritage Program, habitat association models by Rocky Mountain Bird Observatory, and HabsPops models by Intermountain West Joint Venture

Title	Lead Sponsor / PI	Product Due Date	Funding Allocation
A Landscape Analysis and Monitoring Program for Waterton-Glacier International Peace Park and the Greater Crown of the Continent Ecosystem, Phase I	**Crown Managers Partnership / McDermid, G**	**11/11–1/13**	**FY10 $50K FY11 $75K**
Crown of the Continent Landscapes Analysis/Ecological Indicators Project, Phase II: Transboundary Data Integration and Habitat Connectivity			

FY 2010

The monitoring strategy will focus on the development and acquisition of geospatial datasets

from remote sensing and other GIS sources designed to track changes in habitats and human footprint consistently and reliably across the CCE.

Deliverables:

1. A methodology to acquire landscape-level baseline and trend information and tools for tracking management efforts
2. Spatially-explicit geospatial layers:
    a. Critical evaluation of: roads, geo-administration, hydrology, land cover, and disturbances
    b. Develop and retain a significant capacity for 'filling in' missing or unreliable information
    c. Create base maps for each of the monitoring indicators for which no suitable pre-existing GIS alternatives exist in part by developing software tools for assisting automated or semi-automated work flow
3. Collect calibration/validation data for remote sensing-based reference maps
4. Develop strategies for monitoring changes in these indicators including determining status and trends of selected metrics of landscape composition, structure, and function for multiple reporting units

FY 2011

Objectives:

- Conduct habitat connectivity analysis for grizzly bear, Canada lynx, bull trout and westslope cutthroat trout at the scale of the CCE
- Conduct a sensitivity analysis that reveals the impacts of errors/ uncertainty in basemap geospatial products on final results
- Engage partners and networks in order to communicate methods, geospatial tools and results across the multiple geographic jurisdictions of the Crown of the Continent Ecosystem and the GNLCC geographic region

Deliverables (due date):

1. Habitat and connectivity maps for grizzly bears and other key species at the scale of the CCE (10/11)
2. Connectivity indices for grizzly bears and other key species (11/11)
3. Report on grizzly bear habitat and connectivity analysis at the scale of the CCE, submitted to an appropriate peer-reviewed journal (4/12)
4. Report on the results of sensitivity analysis and describing the effects of base data errors and uncertainty on landscape analysis, submitted to an appropriate peer-reviewed journal (6/12)
5. Integrated database cataloging and synthesizing freely available and derived data across the CCE; available to CMP partners and collaborators (8/12)
6. Interactive website linked to the existing CMP website with searchable web maps of natural habitat and habitat connectivity, as well as habitat and connectivity reports (8/12)
7. Presentations to and workshops with CMP managers, citizens and public stakeholders (9/12)
8. CMP Annual Forum in 2013 (5/13)

Crown Managers Partnership: http://www.crownmanagers.org/

Projects Supported in FY 2010

Title	Lead Sponsor / PI	Product Due Date	Funding Allocation
Development of a Transboundary Decision Support System to Guide and Implement Conservation, Land Use, Energy, Transportation, and Climate Change Management and Monitoring	**Idaho Department of Fish and Game / Servheen, G.**	**5/12 (some deliverables 5/11)**	**FY10 $135K**

The project is the combination of two pilot projects initiated and funded by the Western Governors' Association (WGA) for development of a Decision Support System (DSS). The project will establish a useful and consistent source of mapped biological information that decision makers and the public can use to identify and understand crucial wildlife habitats and corridors.

Objectives:

Phase I

- Develop and compile natural resource spatial data that is compatible across the four-state project area.
- Complete a connectivity/linkage plan for the project area to implement in Phase 2.
- Select a transboundary subset of species and habitats for Beaverhead Mountains section and Arid Lands project area.
- Define a transboundary compatible model of unfragmented habitats for Beaverhead Mountains section and Arid Lands project area.
- Complete a climate change plan identifying steps, data and outcomes to incorporate results of Pacific Northwest Climate Change Vulnerability and Water Resources in a Changing Climate assessments into the draft DSS.
- Collect technical and public input to assist in development of the DSS.

Phase 2

- Compatible datasets for all transboundary species of greatest conservation need and those that are socially and economically important for the entire project area
- Transboundary categorization of crucial habitat areas, including wildlife linkage
- Draft a list of best practices and management recommendations for corridors and crucial habitats
- Incorporate spatial representations of climate change impacts and develop recommended management actions for reducing and adapting to climate change for fish and wildlife benefit

- Devise a web interface to deploy the draft DSS based on public and technical input

Deliverables (due date):

Phase I (5/11)

1. An inventory of GIS data for all applicable fish, wildlife, and plant occurrence and modeling data
2. A connectivity/linkage plan to produce a connectivity data layer for the project area in Phase 2
3. A transboundary compatible subset of focal species and land cover types for Beaverhead Mountains section and Arid Lands area
4. A transboundary compatible layer defining unfragmented habitats for Beaverhead Mountains section and the Arid Lands area
5. A climate change plan outlining steps and data necessary to produce a climate change assessment, data layers, adaptive management plan and management actions for the draft DSS
6. Summary of technical and public input on DSS development

Phase 2 (5/12):

1. Transboundary compatible datasets for all species of greatest conservation need and socially and commercially important species and habitats within the project area
2. Transboundary categorization of habitats; including wildlife linkage and crucial areas
3. Definitions, protocols, scales, and ranking models associated with project area
4. Draft of best practices and management recommendations for project area
5. Spatial representations of climate change impacts to wildlife and recommended management actions for reducing and adapting to climate change
6. A summary of public and technical input related to project efforts and a final report
7. A beta version of a mapping service and web page through which it can be deployed

Title	Lead Sponsor / PI	Product Due Date	Funding Allocation
Long-term Changes in Environmental Characteristics Required by Sage-grouse Predicted under Climate Change	**US Geological Survey / Knick, S.**	**12/11**	**FY10 $56K**

Identify sage-grouse populations at risk of extinction within the GNLCC based on (1) their relative isolation from neighboring populations and core regions of the sage-grouse distribution and (2) landcover changes predicted under global climate change models. The first year would be used to: (1) develop models of environmental variables that represent an ecological minimum required by sage-grouse, (2) model changes in sage-grouse distribution or population vulnerability relative to changes in these environmental variables predicted under climate change scenarios, and (3) conduct preliminary analyses of genetic variation within and among sage-grouse populations to determine dispersal probabilities. These results benefit management agencies by focusing regional conservation and land management options in regions likely to sustain long-term sagebrush ecosystems.

Deliverables:

1. Manuscript presenting the available data, important environmental attributes, the modeling approach, and preliminary estimates of ecological minimum levels of environmental variables required by greater sage-grouse
2. Report by workshop participants on projected distributions of greater sage-grouse in response to landcover changes predicted under alternative climate change scenarios

Title	Lead Sponsor / PI	Product Due Date	Funding Allocation
GNLCC Multi-dimensional Synthesis	**National Park Service & US Fish and Wildlife Service / McFadzen, M.**	**10/2010**	**FY10 $25K**

The GNLCC Multi-dimensional Synthesis is a synthesis of existing information in four categories to promote a common understanding of situation, existing information and information gaps, as well as providing an index of programmatic, resource and other climate and landscape related information for GNLCC. The synthesis includes: the GNLCC Resource Directory (organizations and initiatives); climate and ecological response (what does existing and projected climate information say and what are expected ecological effects); and monitoring (who is monitoring what).

Deliverables:

This project will provide an online resource to information on organizations, landscape initiatives, and monitoring efforts.

- Resource Directory to Landscape Initiatives and Organizations within the Great Northern Area: http://www.greateryellowstonescience.org/gnlcc

Title	Lead Sponsor / PI	Product Due Date	Funding Allocation
SageSTEP Long-term Ecological Monitoring Network	**Oregon State University / McIver, J.**	**12/31/2010; 12/31/2011**	**FY10 $75K**

Proposed work will monitor for five years vegetation, fuels, wildlife, insects, and weather at 10 Sagebrush Steppe Treatment Evaluation Project (SageSTEP) sites, all of which have been treated to reduce either juniper encroachment (woodland sites) or cheatgrass invasion (sagebrush/cheatgrass sites). Monitoring of treatment response over the long term will lead to a better understanding of the extent to which managers can manipulate vegetation, fuels, and wildlife habitat in the context of climate change.

Deliverables:

1. Annual Reports, December 31 of each year (ecological response to treatment, carbon response, description of fuel bed)
2. Quarterly SageSTEP newsletter, published on website (sagestep.org)
3. Annual manager workshops for federal, state, and private land managers

SageSTEP: http://www.sagestep.org/

Title	Lead Sponsor / PI	Product Due Date	Funding Allocation
National Wetlands Inventory for Idaho, FY2010	**US Fish and Wildlife Service / Bonn, K.**	**9/30/2011**	**FY10 $100K**

Existing hard copy maps will be digitized according to standard National Wetlands Inventory (NWI) protocols to provide complete NWI coverage for the state of Idaho. Where hard copy maps are unavailable, habitat will be interpreted and digital data will be completed by contractors/cooperators.

Deliverables:

Interpreted, delineated, digital wetland habitat data

National Wetlands Inventory: http://www.fws.gov/wetlands

Title	Lead Sponsor / PI	Product Due Date	Funding Allocation
Forecasting the impacts of Climate Change in the Columbia River Basin: Threats to Fish Habitat Connectivity	**US Geological Survey / Maule, A.**	**12/31/2012 (some by 10/30/2011)**	**FY10 $130K**

Fish growth, distribution and movement, foodweb data, river flow and water temperature data will be used to develop spatially-explicit bioenergetics models to assess effects of climate change on the viability of resident salmonid populations based on models being developed by USGS.

Deliverables:

1. Provide annual reports of all activities in October each year
2. Spatially explicit hydrologic and temperature profile GIS maps of the current Methow River, including extended floodplains, and of expected changes under climate change scenarios
3. Bioenergetics models for selected salmonid species based on empirical data from fish and foodweb data collected in the MRB
4. Integration of bioenergetics model outputs (i.e., growth of individuals) with predicted changes in spatially explicit physical environmental variables (i.e., water temperature, flow, habitat availability)
5. Analyses of effects of change in growth of individuals under climate change (i.e., bioenergetics model outputs) to population viability
6. Several peer-reviewed publications will follow from the above products
   Using Analytica software (Lumina Decision Systems): http://www.lumina.com/why-analytica/

Title	Lead Sponsor / PI	Product Due Date	Funding Allocation
Distribution Model for Fishers in the Northern US Rocky Mountains	**US Fish and Wildlife Service & US Forest Service / Schwartz, M**	**8/1/2011**	**FY10 $80K**

The results of this proposed project would provide the first comprehensive identification of fisher distribution in the northern Rocky Mountains, which may serve as a baseline for identifying population trends and changes in distribution over time.

Deliverables:

A species distribution model will be developed in four phases: 1) Compile Distribution Data (7/10); 2) Species Distribution Data (10/10); 3) Biological Link (1/11); and 4) Climate Change Model (8/11). At the completion of phases 2 and 3, the data would be made available to the

USFWS in a report form that includes an explanation of the source data, methods used, interpretations and conclusions. At the completion of phase 4 (by August 1, 2011), a professional quality report incorporating all four phases of the project, suitable for peer-reviewed publication, will be delivered to the USFWS.

Title	Lead Sponsor / PI	Product Due Date	Funding Allocation
The Washington Connected Landscapes Project, Part II: Model Validation	**Washington Department of Fish and Wildlife / Robb, L.**	**9/2012**	**FY10 $60K**

Occurrence, movement, and genetic data collected for greater sage-grouse (*Centrocercus urophasianus*) and mammalian carnivores will be used to validate statewide and ecoregional connectivity models developed by the Washington Wildlife Habitat Connectivity Working Group (see the Washington Connected Landscapes Project Part I for details).

Deliverables:

1. Report entitled “Movement of greater sage-grouse in the Columbia Basin in relation to landscape resistance” to be submitted for publication in a peer-reviewed scientific journal (12/11 & 9/12)
2. Report entitled “Effects of landscape connectivity on persistence of greater sage-grouse leks in the Columbia Basin” to be submitted for publication in a peer-reviewed scientific journal (10/11 & 9/12)
3. Report entitled “Greater sage-grouse gene flow in the Columbia Basin in relation to historical and current patterns of occupation” to be submitted for publication in a peer-reviewed scientific journal (4/11 & 4/12)
4. Reports of noninvasive survey methods and results, including high quality map products (11/10 & 11/11)
5. Reports describing the results of the population genetic assessment of genetic structuring and exchange, including high-quality map products (5/11 & 9/12)
6. Final report, including barrier and linkage zone maps and comparisons with existing products from the WCLP, to be submitted for publication in 1 or more peer-reviewed scientific journal(s) and presented at 2 or more workshops or conferences (9/12)

Washington Wildlife Habitat Connectivity Working Group: http://www.waconnected.org/

Title	Lead Sponsor / PI	Product Due Date	Funding Allocation
Assemblage, Format and Delivery of Downscaled Climate Data and Projections for the GNLCC Focal Area	**US Geological Survey / Hostetler, S.**	**12/2011**	**FY10 $20K**

Deliverables:

Assemble three sets of downscaled climate data (historic) and projections (future) developed by the USGS and the Climate Impacts Group at University of Washington; evaluate data documentation and formatting, and edit or repair as needed; deliver all climate data in a user-friendly format from mirrored data servers located in Corvallis, OR and Bozeman, MT.

Title	Lead Sponsor / PI	Product Due Date	Funding Allocation
Montana—Capacity Support for Decision Support System Development	**Montana Department of Fish, Wildlife and Parks / Hess-Herbert, J.**	**1/2013**	**FY10 $30K**

Montana Department of Fish, Wildlife and Parks (MTFWP) has been involved with developing a crucial areas statewide Decision Support System (DSS) since 2008 in parallel with activities from the Western Governors Association (WGA). In April, 2010, the Crucial Areas Planning System (CAPS) was released. Also in 2010, the WGA provided funding to the 18 western states to begin developing DSSs for crucial areas among and between the 18 western states. MTFWP will be piloting a transboundary DSS for fish, wildlife, and habitats along the Idaho-Montana Divide, beginning in July 2010. MTFWP will also participating in a dual role of advisory and collaboration with the Washington, Oregon and Idaho Columbia Plateau pilot project.

Deliverables:

1. Collaborate, cooperate and engage with the Columbia Plateau pilot and Wyoming pilot as they move forward with developing, designing and implementing their DSSs
2. Incorporate knowledge gained from this coordination into the Idaho-Montana Divide project
3. Begin developing relationships with state fish and wildlife agencies' staff that will continue to build on data sharing, efficiencies and standards
4. Share data from and information about the project with Idaho and Montana through mutually beneficially cooperation to work towards an integrated data management and integrated data to the extent manageable through this grant
5. Develop and share methods, protocols, and spatial analysis tools

Title	Lead Sponsor / PI	Product Due Date	Funding Allocation
Wyoming—Capacity Support for Decision Support System Development	**Wyoming Game and Fish Department / Nordyke, K.**	**11/2012**	**FY10 $60K**

By bringing the majority of data together in a central location, ensuring compatibilities, and providing public access to the data in a web-based environment, a service is provided to and for the public as well as to private industry, wildlife and land management entities and others. A successful outcome will greatly facilitate the appropriate sharing of large quantities of accurate and current data which in turn will leverage existing conservation capacities.

Objectives:

- Data integration needs—identify and prioritize geospatial data best suited for seamless integration across state (ID and MT) lines
- Geospatial data compatibility potential—examine the underlying tabular data formats, attributes, etc and assess the potential compatibility between like data layers
- Data generalization protocols—consider how data can be generalized to meet the needs of pilot DSSs as well as to facilitate seamless integration across state lines

Deliverables:

1. Centralized and highly controlled spatial database environment created and maintained by the Wyoming Geographic Information Science Center at the University of Wyoming (WyGISC). The spatial database will contain all currently available and future developed Wyoming Tier 1 and Tier 2 data as identified by the WGA Wildlife Council's DSS guidance document.
2. An Internet-based mapping application which makes available the most current and accurate spatial representations to a wide network of users (including the public). The open-architectural design will be standardized across agencies and will directly access the spatial database.

Title	Lead Sponsor / PI	Product Due Date	Funding Allocation
Decision Support Tools for Species Populations and Their Habitats Workshop: The EAGLE (Ecosystem Assessment, Geospatial Analysis, and Landscape Evaluations) System	**Yellowstone Ecological Research Center / Crabtree, B.**	**12/2010**	**FY10 $35K**

This workshop introduced and demonstrated key concepts and a series of software tools, which

allow managers, biologists, and conservationists to efficiently evaluate predictors of wildlife space-use and generate spatial models based on that analysis.

Specific content of the workshop:

- Access to free or low-cost remote sensing information on vegetation, climate, habitat metrics, disturbance, etc., in a useable format, including covariate datasets currently available or under development by the NASA Terrestrial Observation and Prediction System (TOPS)
- Explanation of how this information is derived, created, integrated, validated and matched with species data sets prior to analysis
- Demonstration of user-friendly computer tools (ArcGIS and web-based) that access information and provide automated summaries, trends, and visualizations
- Introduction to, and demonstration of, simple-to-sophisticated statistical analysis, modeling, and prediction software tools that are user-friendly and take a 'white-box' (not black box) approach to species distribution and habitat modeling
- Introduction to risk models which integrate remote sensing data with species data, permitting assessment of environmental and cumulative impacts to species populations and their habitats
- Understanding the workflow steps by using a pronghorn example to predict future impacts of climate change on species distribution and demography
- Discussion of end-user needs: what are your specific needs and how can we incorporate them into the final products and DSTs released in 2011

Title	Lead Sponsor / PI	Product Due Date	Funding Allocation
Understanding and Adapting To Climate Change in Aquatic Ecosystems at Landscape and River Basin Scales—A Decision Support Workshop for Integrating Research and Management	**US Forest Service, Rocky Mountain Research Station / Isaak, D.**	**3/2011**	**FY10 $10K**

Workshop goals were to gather a diverse group of researchers and management professionals to focus on three objectives:

- Sharing current information regarding the effects of climate change on aquatic ecosystems,
- Presenting analysis tools that could assist managers in addressing climate change, and
- Discussing management implications of climate change, the utility of existing tools, and future information & analysis needs

Workshop resources:
http://www.fs.fed.us/rm/boise/AWAE/workshops/climate_aquatics_decision_support.shtml

Projects Supported in FY 2011

Title	Lead Sponsor / PI	Product Due Date	Funding Allocation
Development of a Regional Stream Temperature Model for Mapping Thermal Habitats and Understanding Effects of Climate Change in Pacific Northwest Streams	**US Forest Service, Rocky Mountain Research Station / Isaak, D.**	**9/2013**	**FY11 $122K**

Objectives:

- Develop a regional stream temperature model that incorporates important climate drivers, wildfire/riparian conditions, and geomorphic factors
- Use the model to understand and predict both historic and future trends in stream temperatures for all reaches within all streams
- Assess geographic variation in stream temperature sensitivities to climate change and predict effects on thermal habitats for threatened and endangered aquatic species

Deliverables:

A regional stream temperature model across the Interior Columbia Basin (ICB) capable of predicting temperatures throughout all fish-bearing streams in the Pacific Northwest under historic and future climate scenarios. Model outputs for the climate scenarios will be summarized in database tables that were linked to the USGS NHD+ 1:100,000-scale stream hydrology layer. The stream temperature maps developed in this project would also be filtered by species-specific thermal criteria to delineate a range of habitat conditions and changes in these habitats would be summarized for different climate scenarios.

Title	Lead Sponsor / PI	Product Due Date	Funding Allocation
Applying Vulnerability Assessment Tools to Plan for Climate Adaptation: Case Studies in the Great Northern LCC	**University of Washington / Lawler, J.**	**12/2012**	**FY11 $95K**

This project will apply the results of an on-going climate change vulnerability assessment to the management of two complex landscapes. The vulnerability assessment project team will work with mangers, land-owners, and conservation practitioners to explore how:

- Downscaled climate datasets, modeled vegetation changes, and information on estimated species sensitivities can be used to develop climate change adaptation strategies
- Model results and datasets can be made more useful for informing the management of species and landscapes

Deliverables:

1. Climate Adaptation Plan for each of the two case-study regions (Columbia Plateau, Pioneer Mountains/Craters of the Moon)
2. List of specific recommendations for refinement of the vulnerability assessment products and tools, and identify key information needs that will not be met by that assessment
3. Final report for the Great Northern LCC as well as one or more published manuscripts

Title	Lead Sponsor / PI	Product Due Date	Funding Allocation
Understanding Observational, Proxy, and Modeled Climate Data: Outreach, Training, and Support for Managers and Scientists	**US Geological Survey / Pederson, G.**	**12/2012**	**FY11 $25K**

The project will:

- Produce informational products tailored for users with a diversity backgrounds and needs
- Develop user awareness of strengths and weaknesses (i.e., uncertainties) in observed, proxy, and modeled climate data
- Provide targeted workshops for GNLCC scientists and resource managers

Deliverables:

1. Mirrored FAQ website providing general overview on differences, uncertainties, and

appropriate uses of various GCM downscaling approaches and datasets:
    a. Specific to region
    b. Provides links to specific project websites for data access and more in-depth information
2. USGS Fact Sheets covering regionally relevant downscaled GCM and RCM climate data, historic observed hydroclimatic data sets, and paleoclimatic and hydrologic datasets
3. A series of 2-3 targeted workshops on the use and utility of observed and downscaled climate data for vulnerability assessments and adaptation planning
4. Videos and webinars providing highlights from the workshops and information featured on the FAQ website
5. Annotated slide sets for use in internal agency trainings
6. Comprehensive outreach (i.e., in-person seminars, webinars and phone conferences) within the GNLCC to support understanding and use of data by regional managers and scientists

Title	Lead Sponsor / PI	Product Due Date	Funding Allocation
Great Northern Landscape Conservation Cooperative Geospatial Data Portal Extension: Implementing a GNLCC Spatial Toolkit and Phenology Server	**US Geological Survey / Kern, T.**	**5/2012**	**FY11 $134K**

The set of data development and presentation tools planned will allow GIS analysts in the GNLCC community to work with multiple themes inside the GNLCC geospatial portal. Users will be able to work with phenology imagery layers, define presentation options, and deliver on-line viewers that can be used by the GNLCC community at large and, ultimately, the public.

Deliverables:

1. Support the GNLCC geospatial data portal, including the versioned project geodatabase and ArcGIS Server cluster
2. Provide a way for GIS Analysts to access phenology imagery data to develop derived products and store these artifacts in the project repository
3. Augment the existing ArcGIS Server cluster to support the generation of multi-theme web services, providing a way for users to develop and store map service definitions on the geospatial data portal;
4. Provide a system to allow GIS Analysts to conveniently define dataset presentation options, including symbology, attribute-based representation, and access restrictions

5. Provide an expert workflow where ArcGIS analysts and modelers can design and deploy their own Web or client application by calling Web Services from the GNLCC repository and catalog
6. Provide a "straight to the mapper" approach, designed to let a user call up and interactively select and display layers on a client tool, like Arc Explorer
7. Develop format, structure, and methodology for documenting map packages as distinct artifacts associated with the project

Title	Lead Sponsor / PI	Product Due Date	Funding Allocation
Establishing Aquatic Monitoring Programs for Large-Scale Restoration Projects: Building Understanding for Watershed Conservation in the Face of Climate Change	**The Wilderness Society & US Forest Service / Carlson, A.**	**12/2012**	**FY11 $88K**

Objectives:

- Pilot and adapt the Forest Service PACFISH INFISH Biological Opinion Effectiveness Monitoring Program (PIBO; http://www.fs.fed.us/biology/fishecology/emp/) to determine the number of sampling sites required to establish relationships between road systems and current stream and watershed conditions across the landscape
- Pilot and adapt the Geomorphic Road Analysis and Inventory Package (GRAIP; http://www.fs.fed.us/GRAIP/index.shtml) to facilitate effective monitoring of the effects of road-related restoration projects at both site and watershed scales
- Identify streams that have been most severely impacted by climate change to date within the Crown of the Continent by correlating streamflow and temperature analyses from 1950-2008 with distributions of threatened and endangered native trout species

Deliverables (due date):

1. List of the condition of watersheds in the southern Great Northern Landscape and where climate change is having the greatest impact on stream discharge from 1950-2008
2. List of the most vulnerable watersheds in the region and species of concern within the ecosystem in order to prioritize restoration efforts (11/12)
3. Data sharing within the GNLCC. Data and data summaries will be made available to agency, university, and conservation organization staff within the SWCC as well as the general public via the SWCC website (11/12)
4. Estimates of the costs of aquatic monitoring protocols (11/12)
5. Statistically-defensible, demonstration-site tested protocols for use in monitoring streams and watersheds across the Crown of the Continent pre- and post- restoration treatment (12/12)
6. Ability to implement adaptive management on three National Forests within the Crown of the Continent landscape (12/12)

7. Detailed summary report that outlines findings within the region and each watershed to share with communities, local agencies, and critical organizations to prioritize research, restoration and mitigation efforts; final report to the GNLCC (12/12)
8. Multiple peer-reviewed publication(s) of the studies (2012-13)

Title	Lead Sponsor / PI	Product Due Date	Funding Allocation
Tracking Wetland Changes over Time at Multiple Scales in Bird Conservation Regions 9 and 10	**Ducks Unlimited Canada, Sargent, T.**	**12/2012**	**FY11 $50K**

Deliver the pilot component of a wetland tracking project initiated by the CIJV in 2010. The wetland trend project will deliver an assessment of wetland trends and develop an approach for tracking wetland trends into the future; this will have relevance to conservation planning throughout transboundary ecological planning units, including Bird Conservation Regions (BCRs) 9 and 10, and the Cold Deserts and Western Cordillera Ecoregions.

Deliverables:

While this project will provide a preliminary trend assessment for the study area, the principal goal is to evaluate the proposed wetland tracking approach, identify constraints, and provide recommended procedures and logistics to deliver a landscape scale operational wetland tracking project that can be applied to cross-boundary ecoregional landscapes, i.e., the IWJV and GNLCC.

Title	Lead Sponsor / PI	Product Due Date	Funding Allocation
Communicating and Involving the Public and Stakeholders in the Use of Fish And Wildlife Data and Information for Purposes of Landscape Level Management and Decision Support	**Idaho Department of Fish and Game / Servheen, G.**	**12/2012**	**FY11 $75K**

Objectives:

- Communicate how the WGA wildlife corridors initiative has initiated pilot projects and how the ID, MT, WA, and OR state fish and wildlife agencies are implementing development of regional DSSs using the best scientific data and information available to them
- Strengthen and broaden the range of persons and groups who are informed about

landscape science, wildlife connectivity, and infrastructure development

- Identify and engage stakeholders in providing input in development of the DSS and its use, access, and interface using geospatial and web-based technology
- Develop public and stakeholder support for release of the DSS based on conservation benefit and an economic and efficient business model
- Coordinate development and release of state DSS among Idaho's pilot partners (MT, WA and OR) to insure positive and coordinated messaging concerning its objectives, its development, its use, and how customers were involved in its development

Deliverables:

1. Key messaging and talking points for Department leadership, Commissioners, WGA staff, and other key stakeholders
2. Communication tools and messages for use with all audiences and technology
3. Speakers who are willing and able to travel and provide presentations
4. Social media messages and updates
5. Webinars on DSS development, stakeholder involvement, and use
6. Responses to requests for information, feedback, and development of web interface
7. Power point presentations for presentation to different audiences and messages
8. Customer sensitive design, look, and tone of DSS interface

Appendix I: Product Details of Projects Supported by GNLCC in FY 2010 and 2011

PRODUCT	COUNT	SOURCE	DUE DATE	URL / NOTES
Digital Data				
Spatial data layer/database	>325			
Land Cover Land Use		WA Connected I	done	http://waconnectedorg/
Forest Structure		"	"	"
Forest Cover		"	"	"
Elevation		"	"	"
Slope		"	"	"
Acres Per Dwelling Unit		"	"	"
Freeway		"	"	"
Major Highway		"	"	"
Secondary Highway		"	"	"
Local Road		"	"	"
WHCWG_Project Area		"	"	"
Boundary		"	"	"
Narrow Network*		"	"	" (*3 guilds)
Moderate Network*		"	"	" (*3 guilds)
Wide Network*		"	"	" (*3 guilds)
Active Least Cost Paths^		"	"	" (*16 species)
Active Sticks^		"	"	" (*16 species)
Inactive Least Cost Paths^		"	"	" (*16 species)
Inactive Sticks^		"	"	" (*16 species)
Habitat Concentration		"	"	" (*16 species)
Areas (polygon)^		"	"	" (*16 species)
Habitat Concentration		"	"	" (*16 species)
Areas (raster)^		"	"	" (*16 species)
Cost Weighted Distance (meters)^		"	"	" (*16 species)
Cost Weighted Distance (integer km)^		"	"	" (*16 species)
Normalized Least-Cost Corridors (mosaic)^		"	"	" (*16 species)
Normalized Least-Cost Corridors (clipped to 100K meters)^		"	"	" (*16 species)
Normalized Least-Cost		"	"	" (*16 species)

Corridors (clipped to 100Km)^				
Resistance^		“	“	“ (*16 species)
Columbia Plateau data		“	12/11	
Climate-refugia linkage data		“	7/12	
Focal species and land cover types for Beaverhead Mountains		ID/MT Transboundary	5/11	
Layer defining unfragmented habitats for Beaverhead		ID/MT Transboundary	5/11	
Transboundary compatible datasets for all species of greatest conservation need and socially and commercially important species and habitats		ID/MT Transboundary	5/12	
Wildlife linkage and crucial areas		ID/MT Transboundary	5/12	
Climate change impacts to wildlife		ID/MT Transboundary	5/12	
High resolution climate data sets		Flathead River Project	2011	
High resolution (<1m) habitat classification		Flathead River Project	2011-14	
Fine scale species distribution modeling with supportive data		Flathead River Project	2011	
Interpreted, delineated, digital wetland habitats, Idaho		Nat’l Wetlands Inventory	10/11	
Methow River hydrologic and temperature profiles		Columbia R. Climate Change	12/12	
BCR 10 wide grid		Bird Conservation	12/12	
54 Spatially-explicit bird density estimates		Bird Conservation	12/12	
Roads		Crown of the Continent I	?	
Geo-administration		Crown of the Continent I	?	
Hydrology		Crown of the Continent I	?	
Land Cover		Crown of the Continent I	?	
Disturbances		Crown of the Continent I	?	
Base maps for each of the monitoring indicators for which no suitable pre-existing GIS alternatives exist		Crown of the Continent I	?	
Custom phenology imagery		LC MAP Team	5/12	
Watershed condition and vulnerability to climate change		Aquatic Monitoring Program	5/12	
Integrated database cataloging and synthesizing freely available and derived data across the CCE		Crown of the Continent II	8/12	

Dynamically Downscaled Climate Projections for Columbia and Missouri basins (CIG data)		Downscale Climate Project	10/11	
Statistically Downscaled Climate Projections for Western US (Hostetler data)		Downscale Climate Project	10/11	
Statistically Downscaled Climate Projections for Western US (Shaffer data)		Downscale Climate Project	10/11	
Tier 1 & 2 data for WY DSS		Wyoming DSS	11/12	
Maps	>28			
[Associated maps from spatial data]		WA Connected I	done	http://waconnected.org/
Columbia Plateau regional maps		WA Connected I	7/12	
Noninvasive survey results		WA Connected II	11/11	
Sage-grouse population genetic structure		WA Connected II	9/12	
Barrier and linkage zone maps		WA Connected II	9/12	
Habitat and connectivity maps for grizzly bears		Crown of the Continent II	10/11	
Habitat and connectivity maps for Canada lynx		Crown of the Continent II	10/11	
Habitat and connectivity maps for bull trout		Crown of the Continent II	10/11	
Habitat and connectivity maps for westslope cutthroat trout		Crown of the Continent II	10/11	
Searchable web maps of natural habitat and habitat connectivity		Crown of the Continent II	8/12	
Tables	6			
Focal Species Resistance		WA Connected I	done	http://waconnected.org/
Focal Species Resistance Values		"	"	"
Inventory of GIS data for applicable occurrence and modeling data		ID/MT Transboundary	done	
Database of collared black bears and hair snagging		Fine-scale Linkages	4/13	
Climate change effects on stream discharge by watershed		Aquatic Monitoring Program	11/12	
Vulnerable watersheds and species of concern for restoration priority		Aquatic Monitoring Program	11/12	

Tools				
Spatial Analysis	6			
WA Connected linkage mapper		WA Connected I	done	http://waconnected.org/
Enhanced linkage modeling tools		WA Connected I	9/12	
Project geodatabase and ArcGIS Server cluster		LC MAP Team	5/12	
Multi-theme web services generator		LC MAP Team	5/12	
Map symbology tool		LC MAP Team	5/12	
Expert workflow tool		LC MAP Team	5/12	
Decision Support	5			
"Climate-smart" Columbia Plateau connectivity DS		WA Connected I	10/11	
Mapping service (beta version)		ID/MT Transboundary	5/12	
Species-specific decision support tools (Bayes nets)		Flathead River Project	2012	
Tools for tracking management efforts		Crown of the Continent I	?	
Internet Mapper for WY DSS		Wyoming DSS	11/12	
Models	5			
Bioenergetics models for selected salmonid species		Columbia R. Climate Change	[12/12]	Dependent on suppl. funding
Energetics-environmental linkage models		Columbia R. Climate Change	[12/12]	Dependent on suppl. funding
Salmonid viability analysis		Columbia R. Climate Change	[12/12]	Dependent on suppl. funding
Bird pop'n – habitat conservation models		Bird Conservation	12/12	Contingent on partner work
Interior Columbia Basin regional stream temperature model		Stream Temp. Modeling	9/13	
Information / Training	7			
GNLCC Resource Directory		GNLCC Staff	Done (ongoing)	http://www.greateryellowstonescience.org/gnlcc
FAQ Website climate approaches		Climate Data Training	12/12	
Fact Sheet – downscaled data		Climate Data Training	12/12	
Videos of training sessions		Climate Data Training	12/12	
Annotated slide programs		Climate Data Training	12/12	
Key messaging and talking points		IDFG-WGA Outreach	12/12	
Social media messages and		IDFG-WGA Outreach	12/12	

updates				
Reports				
Agency – Planning	13			
Adaptive management protocols to inform future "climate-smart" connectivity planning		WA Connected	7/12	
Connectivity/linkage workplan		ID/MT Transboundary	5/11	
Plan outlining steps and data necessary to produce a climate change assessment		ID/MT Transboundary	5/12	
Methodology to acquire landscape-level baseline and trend information		Crown of the Continent I	?	
Strategies for monitoring changes in key indicators		Crown of the Continent I	?	
Fisher distribution data		Fisher Distribution Model	6/10	
Fisher distribution models		Fisher Distribution Model	9/10	
Fisher biological link report		Fisher Distribution Model	12/10	
Climate Adaptation Plan (Columbia Plateau)		Vulnerability Assessment	12/12	
Climate Adaptation Plan (Pioneer Mts., ID)		Vulnerability Assessment	12/12	
Protocols and estimated costs for use in monitoring streams and watersheds		Aquatic Monitoring Program	12/12	
Ability to implement adaptive management on three National Forests		Aquatic Monitoring Program	12/12	
A landscape scale operational wetland tracking project for cross-boundary ecoregional landscapes		Wetland Tracking Project	12/12	
Agency – Results	15			
WA Connected Statewide Analysis		WA Connected I	Done	http://waconnected.org/
Columbia Plateau ecoregional analysis			12/11	
Climate-refugia linkage report			7/12	
Draft of best practices and management recommendations		ID/MT Transboundary	5/12	
Recommended management actions for reducing and adapting to climate change		ID/MT Transboundary	5/12	
Projected distributions of		Knick et. al	12/11	

greater sage-grouse in response to landcover changes predicted under alternative climate change scenarios				
Grizzly bear habitat modeling		Fine-scale Linkages	4/13	
Black bear habitat modeling			10/11	
Genetic-based parent-offspring analysis			12/11	
SageSTEP Annual Reports		SageSTEP	1/11,1/12	
Annual Report		Columbia R. Climate Change	10/11	
Annual Report		Bird Conservation	3/11, 3/12	
Field validation of WA Connected Landscape sage-grouse connectivity models		WA Connected II	9/12	
User's Manual	1			
Spatial analysis toolset user guide		WA Connected I	done	http://waconnected.org/
Peer-reviewed Publication	17+			
Presentations	10			
Workshops	8			
Long-term changes in environmental characteristics required by sage-grouse predicted under climate change		Knick et. al	12/11	
Results and decision support tools training (2+)		Flathead River Project	2012-14	
Understanding and Adapting To Climate Change in Aquatic Ecosystems at Landscape and River Basin Scales: A decision support workshop for integrating research and management		RMRS – Fish and Aquatic Ecology Unit	3/11 (done)	
Decision Support Tools for Species Populations and Their Habitats: The EAGLE System		Yellowstone Ecological Research Center	12/10 (done)	
Annual SageSTEP manager workshops		SageSTEP	5/11 (done)	
Use of downscaled climate data for vulnerability assessment and adaption training (2-3)		Climate Data Training	12/12	
CMP manager, citizen and public stakeholder workshops		Crown of the Continent II	9/12	

Webinars on DSS development, stakeholder involvement, and use		IDFG-WGA Outreach	12/12	